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MEMOIRS OF THE GEOLOGICAL SURVEY OF NEW SOUTH WALES.

E. C. ANDREWS, B.A., F.G.S., GOVERNMENT GEOLOGIST.

PALÆONTOLOGY, No. 12.

MESOZOIC FLORAS OF NEW SOUTH WALES.

PART I.—FOSSIL PLANTS FROM COCKABUTTA MOUNTAIN AND TALBRAGAR.

BY

A. B. WALKOM, D.Sc.,

Secretary, Linnean Society of New South Wales

SYDNEY: WILLIAM APPLEGATE GULLICK, GOVERNMENT PRINTER.

1921.

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Podozamites lanceolatus, Lindley and Hutton, and *Taeniopteris spatulata*, McClelland.

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INTRODUCTION.

The fossil plants described in the following pages represent collections from two localities, viz. :—Cockabutta Mountain, and Talbragar. From the former only a few specimens are available, poorly preserved in a fine-grained ferruginous shale; from the latter, on the other hand, specimens are very numerous, and are well preserved as white siliceous impressions on an ochreous coloured shale. This method of fossilisation unfortunately does not lend itself to the preservation of internal structure. Associated with the plants at Talbragar are very numerous fish remains which have been described by A. S. Woodward,[1] and also a single insect (*Cicada ? Lowei*) described by R. Etheridge, junior, and A. S. Olliff.[2]

I desire to express my indebtedness to Mr. W. S. Dun, Palæontologist to the Geological Survey, through whose generosity I have been able to examine and describe these collections of plants. I have also to thank Mr. J. Mitchell for allowing me to examine his collection of fossil plants from Talbragar.

[1] Mem. Geol. Surv. N.S.W., Pal. No. 9, 1895. [2] *Ib.*, No. 7, 1890, p. 6.

PREVIOUS RECORDS.

This interesting occurrence of fossils was first discovered by Mr. Arthur Lowe, of Wilbetree, and collections were made from the locality by Mr. C. Cullen.[1]

A preliminary examination of the plants was made by the late R. Etheridge, junior, who stated[2]: "The most conspicuous plant is a *Tæniopteris*, which Professor McCoy is unable to distinguish from his *T. Daintreei*, so characteristic of the Victorian Mesozoic deposit." He also drew attention to the importance of the plants as indicating an alliance of the rocks with the Clarence Series of New South Wales, the Ipswich Series of Queensland, and the Wannon and Bellarine beds in Victoria.

The fossil fishes from Talbragar were described by Dr. A. S. Woodward,[3] a note on the stratigraphical relations of the beds being contributed by Professor T. W. E. David and Mr. E. F. Pittman. In this note on the stratigraphy, the occurrence of fossil plants is recorded, not only from the Talbragar Beds, but also from a bed of hard red ferruginous shale about a foot thick, some 3 miles south-east of Cockabutta Mountain, and only a short distance north-west of the Talbragar Beds. This bed of shale was believed by Professor David and Mr. Pittman to belong to the Hawkesbury Series, which immediately underlies the Talbragar Fish and Plant Beds. From the shale bed the following list of plants was recorded, the determinations having been made by Mr. W. S. Dun.[4]

Tæniopteris ?
Alethopteris australis, Morris.
Thinnfeldia odontopteroides, Morris.
Thinnfeldia sp.
Phyllopteris Feistmanteli, Eth. fil. (?).
Sphenopteris sp.
Detached leaves referable to *Baiera* or an allied plant most probably.

Attention was directed to the "goffered" margin of the *Tæniopteris* (?), as being quite distinct from any known specimens of *T. Daintreei*, which was common in the Talbragar Beds.

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[1] *See* Mem. Geol. Surv. N.S.W., Pal. No. 9, 1895, p. vii.
[2] Ann. Rept. Dept. Mines, N.S.W., 1889 (1890), p. 237.
[3] *Loc. cit.*
[4] *Op. cit.*, p. x.

From the Fish Bed, they recorded the following plants, the identifications being those of Mr. W. S. Dun :—

Tæniopteris Daintreei, McCoy.
Podozamites lanceolatus, L. & H.
Thinnfeldia odontopteroides, Morris.
Thinnfeldia sp.
Taxites (cf. *T. planus*, Feistmantel).
Neuropteridium australe (?), Tenison-Woods.
Sphenopteris sp.

In addition they also quote the following species as having been determined by the late Mr. R. Etheridge, junior, among the material collected by Mr. Cullen :—

Thinnfeldia odontopteroides, Morris.
Tæniopteris Daintreei, McCoy.
Podozamites lanceolatus, L. & H.
Podozamites spathulatus, Feistmantel.
Podozamites longifolius, McCoy.
Podozamites sp.

With regard to the stratigraphical position of the Beds their conclusions (p. xiii) may be quoted : " The stratigraphical evidence obtained would seem to indicate that these beds were deposited in a hollow of erosion in the sandstones of the Hawkesbury Series, for the following reasons :—

(1). The Fish Beds differ in lithological character from any rock known to occur elsewhere in the Hawkesbury Series.

(2). They thin out rapidly against the sandstone of the latter formation, which rises to a considerable height on their margin, and is nowhere seen to overlie them."

In their opinion the balance of evidence is in favour of a Jurassic age for the Fish Beds. This was supported by Mr. A. S. Woodward's conclusion from an examination of the fish, of which all the species described were new, that " The Talbragar fish-fauna is, therefore, probably not earlier than the Upper Lias, and may be referable to the Lower Oolites."[1]

Mr. W. S. Dun, in a paper " Notes on the Australian *Tæniopterideæ*' (Aust. Assoc. Adv. Sci., vii (1898), p. 384) records the occurrence of *Tæniopteris* sp. and *Phyllopteris* sp. from Cockabutta Mountain, and of *Tæniopteris*

[1] *Op. cit.*, p. 26.

(*Angiopteridium*) *spathulatum* from Talbragar. The specimens of *Tæniopteris* sp. are those noted by Professor David and Mr. Pittman as having a " goffered " margin. It is interesting to note that examination of the numerous specimens of *Tæniopteris* from Talbragar led Mr. Dun to conclude that the Australian *T. Daintreei*, McCoy, was synonymous with the Indian *T. spathulatum*, McClelland. He says (pp. 392–3), " . . . and after an examination of a large number of specimens from the Jurassic beds of the Talbragar River and comparison with Victorian and Queensland specimens we are, I consider, compelled to admit that the Eastern Australian *Tæniopteris*, hitherto known generally as *Daintreei*, McCoy, is nothing but the variable Australian representative of the Indian *Angiopteridium spathulatum*, McClelland."

In his memoir on the Geology and Mineral Resources of the Western Coalfield,[1] Mr. J. E. Carne quotes the lists of fossils already referred to, and agrees with the conclusions of Professor David and Mr. Pittman as to the age of the Talbragar Beds.

In 1918, in drawing up a correlation of the various Mesozoic Plant-bearing beds of Australia, I placed the Talbragar Beds as Jurassic and equivalent to the Clarence Series and Artesian Series of New South Wales, and the Walloon Series in Queensland.[2] At the time of drawing up that table, no further information was available than is comprised in the lists quoted above.

In connection with the correlation of the Talbragar Beds with the Ipswich Series in Queensland by earlier authors, it should be remembered that up till at least 1907 the beds known as the Ipswich Series included rocks of both Triassic and Jurassic Ages. The term Ipswich Series is now confined to the lower portion, of Triassic age, while the upper portion is of Jurassic age, and is known as the Walloon Series. Both contain abundant plant fossils, and they are separated by a series of barren sandstones—the Bundamba Series.[3]

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[1] Mem. Geol. Surv. N.S.W., Geol. No. 6, 1908, p. 32.

[2] Proc. Linn. Soc. N.S.W., xliii, 1918, p. 95 (table x).

[3] For fuller discussion of this *see* Proc. Linn. Soc. N.S.W., xliii, 1918, pp. 45 et seq.

FOSSIL PLANTS FROM COCKABUTTA MOUNTAIN.

The specimens from the ferruginous shale at Cockabutta Mountain are few in number and are not sufficiently well preserved to warrant detailed description. They include examples which may without doubt be referred to *Cladophlebis australis* (Morris), *Thinnfeldia* sp., *Sphenopteris* sp., and *Tæniopteris* sp., and also specimens of what may be a Tæniopteroid leaf.

The few pinnules referred to *Thinnfeldia* (F3129) are short and rounded, and have the veins springing from the base; they therefore may belong either to *T. Feistmanteli* or to *T. odontopteroides*. Two specimens (F3130*a*, F3134) show a *Tæniopteris*, whose leaf is about 1·4 cm. wide, with the midrib finely vertically striated and less than 1 mm. wide. The secondary veins come off at an acute angle, and soon bend so that they are at right angles to the midrib; at the margin of the leaf there are about 8 veins in a distance of 5 mm. The secondary venation suggests a comparison with *T. Carruthersi*, Tenison-Woods. An example of this is figured in Plate III, fig 3.

Other specimens (F3131, 3133) show a strap-shaped leaf about 1 cm. wide, with a prominent midrib, which shows 2 or 3 vertical striations, and is about 1 mm. wide. The lamina shows a series of folds at right angles to the midrib, producing a corrugated appearance of the portions of the lamina on each side of the midrib, about four corrugations showing in a space of 1 cm. The specimens exhibit no further detail of structure, and it is impossible at present to say whether or not the corrugations may be due to the presence of sori on the underside of the leaf. It may be remarked that similar specimens have been observed among a series of plants from the Wianamatta Series collected by Mr. John Mitchell. This collection of Mr. Mitchell's is shortly to be described. The only conclusion that can be safely drawn at present is that these represent leaves which *possibly* belong to *Tæniopteris*.

A single specimen (F3130) may be referred to *Sphenopteris*, but there is not sufficient of it for specific determination. It has rather wedge-shaped pinnules, somewhat similar to those of *Sphenopteris ampla* from the Jurassic rocks in Victoria.

These determinations only differ from those of Mr. Dun, quoted above, in the absence of *Phyllopteris Feistmanteli* (*?*). It seems probable that the specimens which I have compared with *T. Carruthersi* are those which were previously doubtfully assigned to *P. Feistmanteli*.

This assemblage of plants is quite insufficient for determining the age of the beds at Cockabutta Mountain. It may only be remarked that *Taniopteris Carruthersi*, with which some specimens are compared, occurs in the Ipswich Series, of Upper Triassic (possibly Rhætic) age, and doubtfully in the Walloon Series (Jurassic); and that the peculiar Tæniopteroid leaf described occurs in the Wianamatta Series (Upper Triassic), which is believed to be equivalent to the Ipswich Series of Queensland.

FOSSIL PLANTS FROM THE TALBRAGAR BEDS.

(*a*) *Descriptions of the Specimens.*

FILICALES.

Osmundaceæ (*?*).

Cladophlebis australis (Morris).

(Plate II, figs. 5, 6.)

[For synonymy *see* Seward (04*a*), p. 171, and Walkom (17), p. 3.]

The specimen figured on Plate II, fig 5, represents the apical portion of a small frond of *Cladophlebis australis*. Such specimens are very sparsely represented in the collection, but there is little difficulty in identifying this type of frond. Considering that *Cladophlebis australis* is such a common type in the Jurassic flora as known from other Australian occurrences, it is rather remarkable that it is not more abundant in the Talbragar collection.

The specimen figured (F3144) serves as a record of the species from the locality.

Cyatheaceæ.

Coniopteris hymenophylloides (Brongn.).

(Plate I, figs. 3–6.)

This species was first described by Brongniart in 1829. It is of world-wide occurrence in Jurassic rocks. For full synonymy reference may be made to Seward (04 *a*), p. 163, and Arber (17), p. 32.

Seward's definition of the species is: "Frond tripinnate; pinnæ linear acuminate, attached to the rachis at a wide angle; the pinnules vary considerably in size and shape, in some forms they have a few broad and rounded lobes, and in others the lamina is deeply dissected into narrow linear segments. The fertile pinnules bear the sori at the end of the veins; the lamina is usually much reduced, and in extreme cases the fertile segments agree closely with those of *Thyrsopteris elegans*, Kze., or *Dicksonia Bertevana*, Hook. The sori are partly enclosed in a cup-shaped indusium; the sporangia appear to have an oblique annulus of the cyatheaceous type. The two lowest pinnules of the pinna are often characterised by their unusual shape, the lower half of each pinnule consisting of long spreading and irregular *aphlebia*-like lobes Venation and form of the frond of the *Sphenopteris* type."[1]

[1] Seward (04*a*), p. 163.

Sterile examples of the species are of common occurrence in the Talbragar collection, but so far no fertile fronds have come under notice. The specimens figured are typical examples, and exhibit no differences from examples figured from other parts of the world. Similar specimens occur in the Jurassic Rocks of Victoria[1] and New Zealand,[2] and also in the Clarence Series of New South Wales.[3]

Thinnfeldieæ.

THINNFELDIA.

Having had the opportunity of examining some of the plates of an unpublished manuscript of Kurtz, I am able to add a little information concerning the distribution of the Australian species of this genus. For the loan of these I am indebted to Mr. W. S. Dun. Kurtz figures numerous examples of *Thinnfeldia odontopteroides*, Fntl., and of *T. lancifolia* from Cacheuta (Mendoza), South America. He also figures a number of specimens, for which his manuscript name is *T. intermedia*, but some of these are without doubt to be referred to *T. odontopteroides*, and the others to *T. lancifolia*. His figures of a proposed new variety, *T. lancifolia* var. *quadrata* appear to be only examples of *T. odontopteroides*. Other figures are labelled *T. lanceolata* (Morr.) Szajn.; this is probably meant for *T. lancifolia*. Szajnocha[4] had earlier described and figured both *T. odontopteroides* and *T. lancifolia*, from the same locality, and also gave a figure of a new species of *Cardiopteris*, *C. zuberi*. His figure[5] of this is obviously portion of a frond of *Thinnfeldia Feistmanteli*.

The three common species of *Thinnfeldia* in the Triassic and Jurassic rocks of Australia are therefore well represented in rocks of similar age in South America.

Antevs,[6] in a paper only recently to hand, records and figures *T. Feistmanteli* from Mayils Well, near Derby, North West Australia, embedded in a light-gray clay at a depth of 300 feet. This is, as far as I know, the first record of any such fossil from North West Australia, and its occurrence in association with a fragment of *Ptilophyllum ?* would seem to indicate a Jurassic age for some of the rocks in that region.

[1] Seward (04*a*), p. 163, figs. 6-9.

[2] Arber (17), pp. 32-34.

[3] Walkom (19), p. 183.

[4] Uber fossile Pflanzenreste aus Cacheuta in der Argentinischen Republik. Sitz. K. Akad. der Wiss., xcvii, 1889, pp. 219-245.

[5] *Op. cit.*, t. 2, fig. 1.

[6] K. Sv. Vet. Akad., Handl., lii, No. 5, 1913.

It is interesting to note that, while Antevs refers the specimens to Gothan's proposed genus, *Dicroidium*, at the same time he points out that in the character of the stomata they agree with *Thinnfeldia* and not *Dicroidium*. With regard to these two genera, he says :—" No doubt it would be better to exclude the structure of the cuticle from the diagnosis until different forms of *Dicroidium* and *Thinnfeldia* have been examined in this respect; for there may be sufficiently great and numerous differences, all the same, for a separation of the two genera." His remarks only serve to strengthen my opinion already expressed, that the evidence available does not justify the separation of the genus *Dicroidium* from *Thinnfeldia*.[1]

Thinnfeldia Feistmanteli, Johnston.

[For synonymy *see* Walkom (17), p. 17.]

" Frond bipinnate, paripinnate with a dichotomous rachis; apex is formed by a dichotomous branching of the rachis. Pinnæ elongate, gradually tapering, alternate or opposite. Pinnules rhombic, ovate or semi-circular, thick, attached by whole of base, and connected by very narrow lamina along the rachis. Venation odontopteroid, the veins springing directly from the rachis and dividing once or twice before reaching the margin. Similar pinnules occur on the rachis between the pinnæ, but in this position they may be slightly contracted at the base. Sori circular, composed of 3 to 5 sporangia. Walls of sporangia made up of elongate polygonal cells, and apparently there is no annulus."[2]

Normal sterile examples of this species are to be seen in the collections from Talbragar, but they are not numerous. The species has recently been discussed at some length,[3] and there is no need to do more here than record its occurrence at Talbragar.

Thinnfeldia talbragarensis, n.sp.

(Plate I, figs. 1, 2; Plate II, figs. 7–9.)

Frond bipinnate. Pinnæ variable—some of the same type as *T. lancifolia*, some with markedly wavy margins, and others with the lamina distinctly divided after the manner of *T. Feistmanteli*. Pinnæ narrow at base and attached to rachis only by narrow portion. The venation in the simple pinnæ is alethopteroid, while in those pinnæ resembling *T. Feistmanteli*, the pinnules have the typical odontopteroid venation.

[1] Walkom (17), p. 15.
[2] Q'land. Geol. Surv., Pub. 257, 1917, p. 18.
[3] Walkom (17), p. 17.

The specimens referred to this species are intermediate in character between *T. lancifolia* and *T. Feistmanteli*. The bipinnate nature of the frond and the narrowing at the base of the pinnæ show it to be more closely comparable with *T. Feistmanteli*.

The Australian Thinnfeldias have been the subject of much discussion in the past, and there are still a number of problems to be solved in this group. The occurrence of the species here described is an important addition to our knowledge of the genus, and it suggests that we may be dealing with an even more variable species than has been generally thought.

It is expected that an examination of a representative collection of Mesozoic plants from Tasmania will shortly be undertaken, and when that is completed it may be possible to deal more satisfactorily with the Australian species of *Thinnfeldia* than at present.

Thinnfeldia pinnata, n.sp.

(Plate II, figs. 1–4.)

Frond pinnate; pinnæ linear, elongate, 12·5 cm. or more long, 1·8 cm. or more wide. Pinnules short, bluntly rounded, alternate or opposite, attached by whole base, separate or connected by narrow lamina along rachis, up to 8 mm. long and 6 mm. broad, margins entire. Midrib well defined, not reaching to apex, but breaking up into a number of veins. Secondary veins come off from midrib at an acute angle, and divide dichotomously once or twice. Towards the base of the frond the pinnules become more rounded and their midrib less prominent.

This species of *Thinnfeldia* differs from other described Australian species, especially in the nature of the frond. Practically all those that have hitherto been described have either a bipinnate frond (*T. Feistmanteli*) or a pinnate frond in which the rachis is dichotomously forked (*T. lancifolia*, *T. odontopteroides*, *T. acuta*), the latter feature (the dichotomous forking of the rachis) being very characteristic. In the present species the frond is simple and entire, the absence of any dichotomous forking being clearly shown by the lack of any modification of the basal pinnules on either side of the rachis. Some specimens, as, *e.g.*, that on Plate II, fig. 1, have their basal extremity, very well defined, and may be considered to indicate that the fronds became detached by the development of a distinct abscise layer.

It is possible that some of the specimens figured by Johnston,[1] from Tasmania, may belong to the species under discussion; but on account of the difficulty of drawing satisfactory conclusions from his figures and descriptions it is impossible to institute reliable comparisons.

The type of frond of *T. pinnata* is similar to that of *T. rotundata*, Nathorst,[2] and *T. rhomboidalis*,[3] but the resemblance ends there. *T. rotundata* is a larger, more robust type, and judging from Antevs' figure, the venation is quite different, the secondary veins making a wider angle with the midrib, and only forking very occasionally.

In a recent paper, I referred[4] two specimens from Bexhill, near Lismore, to Arber's genus *Microphyllopteris*. Those specimens had no trace of the venation preserved, and therefore their correct determination was almost impossible; I now suggest that they may be more correctly referred to *T. pinnata* than to *Microphyllopteris pectinata*. Until better specimens are forthcoming from Bexhill, however, it will not be possible to decide this point definitely.

? CYCADOPHYTA.

Tæniopteris spatulata, McClelland.

(*T. Daintreei*, McCoy.)

(Frontispiece; Plate II, fig. 9; Plate III, fig. 1; Plate VI, fig. 8.)

The synonymy of this species is long, and has been given in full by Dun (98, p. 390), and Seward (04, p. 168).

The examination of a very large number of Queensland specimens led me[5] to consider that there was no reason for separating *T. Daintreei*, McCoy, from *T. spatulata*, McClelland, and the numerous examples from Talbragar afford further confirmation of this. This conclusion had been earlier arrived at by Mr. W. S. Dun (see above, p. 4), and had also been suggested by a number of European workers in Palæobotany.

A broad general definition of the species has been given by Seward, thus: "Frond simple, linear, long and narrow, reaching a length of more than 7 cm., and varying in breadth from 1·5 mm. to slightly more than 1 cm. The apex is either gradually tapered to an acuminate tip or bluntly rounded;

[1] Johnston, Geology of Tasmania, 1888.

[2] Antevs (14), t. 4, fig. 1.

[3] Seward (10), fig. 359, p. 542.

[4] Proc. Linn. Soc. N.S.W., xliv, 1919, p. 186.

[5] Walkom (17), p. 30.

towards the petiole the lamina becomes gradually narrower. Midrib stout and prominent, giving off numerous secondary veins, usually at right angles; these veins are frequently forked close to the midrib, or the branching may occur at varying distances between the midrib and the edge of the leaf. The veins are delicate and numerous, approximately fifteen veins per 5 mm. of lamina. Towards the apex of the fronds the secondary veins become oblique, branching at a wide angle from the midrib."[1]

This is perhaps the most characteristic plant of the Australian Jurassic Flora. The specimens from Talbragar are typical examples, and illustrate very well the degree of variation exhibited by the species. In general, the widest part of the lamina is nearer the apex than the base; some specimens show a gradual tapering at the base to a long petiole—in one example with a total length of 13·5 cm., the petiole is about 1·2 cm. long (this specimen has a maximum width of 6 mm.).

? CONIFERALES.

Podozamites lanceolatus (Lindley & Hutton).

(Frontispiece; Plate V, figs. 1–3; Plate VI, figs. 1–2.)

1836,—*Zamia lanceolata*, Lindley & Hutton, Fossil Flora, Pl. 194.

1874,—*Zamites* (*Podozamites*) *ellipticus*, McCoy, Prodromus Pal. Vict., Decade 1, p. 35, t. 8, fig. 4.

1912,—*Podozamites lanceolatus*, Seward, Mem. Geol. Surv. Ind., Pal. Ind., N.S., Vol. iv, Memoir 4, p. 33, t. iv, figs. 54, 56.

1919,—*Podozamites lanceolatus*, Walkom, Qland. Geol. Surv., Pub. 263, p. 49, t. 4, fig. 2.

(For full synonymy of *P. lanceolatus*, *see* Seward (00), p. 242.)

Typical examples of this species are extremely abundant from Talbragar. They consist of a slender axis, whose impression is about 3 or 4 mm. broad, bearing lanceolate leaves, reaching a length of about 6 cm., and a breadth of 7·5 mm. These leaves are undoubtedly spirally arranged, but owing to the flattening down during fossilisation, it is not possible to determine the phyllotaxy. These leaves are traversed by 7 or 8 parallel veins, which arise from the branching of 1 to 3 veins at the base; this branching, however, all takes place quite close to the base of the leaf, and for the greater portion of the leaf there is no branching of the veins, which remain practically parallel

[1] Seward (04*a*), p. 168.

to the tip; in some cases there is a very slight tendency to convergence, amounting merely to a bending inwards of one vein on either side of the central one. As shown on Plate VI, fig. 1, the leaves at the lower end are shorter and somewhat rounded.

The specimens are indistinguishable from figures of the typical *P. lanceolatus*, occurring in Jurassic rocks in other parts of the World.

Although the species is so abundant among the material from Talbragar, none of the specimens gives any indication of the true systematic position of *Podozamites*.

CONIFERALES.

Araucarites grandis, n.sp.

(Plate III, fig. 6.)

Large cone scales, broadly wedge shaped, with very short apical spine. Seed single, elongate.

The scale has a length of about 4·2 cm., and a width of 2·2 cm. at the widest part, narrowing to ·6 cm. at the base. The seed depression is about 2·5 cm. long by ·6 cm. wide.

One other specimen of an Araucarian seed-bearing scale has been described from Jurassic rocks in New South Wales, viz., that from Bexhill, near Lismore, determined as *A. cutchensis*, Feistmantel.[1] The Talbragar specimen is very much larger than that from Bexhill, and it is perhaps advisable to give it a distinct specific name. Araucarian cone scales are now known widely from Jurassic rocks, and in describing them the practice has been generally followed of giving distinct specific names to specimens from rocks of approximately the same age in different areas. This fact should be borne in mind in the comparison of Jurassic floras from different localities. The actual number of names is probably considerably in excess of the number of actual species.

Araucarian scales not differing very greatly from those under discussion have been described from Jurassic strata in England, Germany, India, and Victoria.

Seward[2] describes two scales from Victorian Jurassic rocks as *Araucarites* sp. A., and *Araucarites* sp. B., both differing widely in form from the present example.

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[1] Proc Linn Soc. N.S.W., xliv, 1919, p. 188.

[2] Rec. Geol. Surv. Vict., 1, pt. 3, p. 181, t. xix, figs. 42, 43.

? Brachyphyllum sp.

(Plate III, figs. 4, 5.)

Some small fragments of vegetative coniferous shoots are referred to the genus *Brachyphyllum*. They exhibit a series of small spirally-arranged, sharply-pointed leaves, closely appressed to the stem. The general appearance of the specimens shows a close resemblance to such a species as *Sphenolepidium Kurrianum*,[1] but in the absence of any association with cones it is perhaps advisable to adopt the more non-committal name, *Brachyphyllum*.

Elatocladus plana (Feistmantel).

(Plate IV, figs. 1–4; Plate V, figs. 1–3.)

1879, —*Taxites planus*, Feistmantel, Foss. Fl. Gondwana Sm., 1, pt. 4, t. 13-15.

1883, —? *Taxites medius*, Tenison-Woods, Proc. Linn. Soc. N.S. Wales, 8, p. 160, t. 9, fig. 3.

1902,—*Palissya gracilis*, Shirley, Qland. Geol. Surv., Bull. 18, p. 8, t. 2.

1904,—*Taxites* sp. (?), Seward, Rec. Geol. Surv. Vic., 1, pt. 3, p. 182.

1917,—*Taxites planus*, Walkom, Qland. Geol. Surv., Pub. 259, p. 25, t. 9, fig. 4.

1919,—*Elatocladus planus*, Walkom, *ibid.*, Pub. 263, p. 43, t. 2, figs. 4, 5.

The specimens comprise portions of sterile coniferous fronds, and in the absence of characters which permit them to be included in any of the genera based on fertile specimens, they are referred to Halle's genus *Elatocladus*.

The branches exhibit numerous, long, linear leaves, up to about 4 cm. long and 2 mm. wide, pointed, and with a median vein. The arrangement of the leaves is spiral, as is clearly shown in quite a number of specimens, though in the process of preservation on a flat surface the leaves have become arranged in two comparatively regular series. In a large number (*e.g.*, Plate IV, fig. 1), the leaves are almost at right angles to the stem, while in others (Plate V, fig. 1) they are at a moderately acute angle. There is very little difference between these two, and it is not considered that they are sufficiently distinct to warrant specific distinction. In some, and more particularly in those in which the leaves are more inclined to the axis, the base of the leaf is quite markedly decurrent, and, as Seward suggests,[2] this form of leaf base is

[1] Seward (19), fig. 771, p. 364.

[2] Seward (19), p. 432.

similar to that in *Retinosporites*, Holden, and should anatomical details become available, it may be found necessary to transfer this species to the genus *Retinosporites*.

These plants form a large proportion of the Talbragar collections, and comprise some quite large fronds more than 12 cm. long and 8 cm. across.

? Pagiophyllum peregrinum (Lindley & Hutton).

(Plate III, fig. 2.)

1833,—*Araucaria peregrina*, Lindley and Hutton, Fossil Flora, ii, Pl. 88.

1894,—*Pagiophyllum peregrinum*, Ward, 20th Ann. Rept. U.S. Geol. Surv., p. 308, t. 45.

1904,—*Pagiophyllum peregrinum*, Seward, Jurassic Flora, ii, p. 48, t. 5.

1919,—*Pagiophyllum peregrinum* (?), Walkom, Qland. Geol. Surv., Pub. 263, p. 46.

(For full synonymy *see* Seward (04), p. 48.)

The specimen figured (F3166) is portion of a branch about 10 cm. long with spirally arranged, fleshy, pointed leaves, about 1·2 cm. long, and it may with little doubt be referred to the genus *Pagiophyllum*. It does not appear to differ in any essential feature from the common Jurassic form, *P. peregrinum*, but a single specimen, not too well preserved, is perhaps hardly sufficient to establish specific identity.

Seward's definition of the species is as follows: "Vegetative shoots monopodially branched, bearing crowded, spirally disposed, fleshy leaves. The leaves vary in shape and position; they are usually broadly triangular, sometime reaching a length of 5 mm., imbricate and fairly closely appressed to the stem; in some shoots they are more open in arrangement, and more distinctly falcate. The back of the leaves bears a broad median keel, and the lamina is frequently characterised by numerous longitudinal striations or wrinklings; the apex of the leaf may be obtuse or acuminate."

Pagiophyllum does not appear to have been previously recorded from Jurassic rocks in Eastern Australia; it is known from the Maryborough Series (Marine), and from the Burrum Series of coal measures in Queensland. The

Burrum Series is of Lower Cretaceous age; the Maryborough Series is usually classed as Cretaceous, but attention has already been called to the possibility that it may be Upper Jurassic.[1]

Two species have been described from the Burrum Series,[2] viz. :—
P. Jemmetti and *P. peregrinum* (?).

Cones.

(1). The specimen (F3168) figured on Plate VI, fig. 8, shows the impression of portion of a small cone. The cone was probably about 5 cm. long and 2 cm. in diameter; the scales were spirally arranged, the impressions of their outer ends being rhomboidal in outline (about 3 mm. by 1 mm.).

Determination of such cone impressions is impossible, and it can only be suggested that the present example may be Araucarian, as it is of somewhat similar type to cones occurring in the Jurassic of Australia, which show more definite evidence of Araucarian affinity.

(2). The small cone (?) figured on Plate VI, fig. 7, is another example with which it is impossible to deal satisfactorily. It shows ten or twelve small ovate bodies (possibly seeds) attached to a slender axis, the shape of the whole structure being rather elongate oval.

(3). Another specimen (F3163) which appears to represent a cone, possibly in transverse section, is figured on Plate VI, figs. 4, 4*a*. It is oval, tending towards circular, in shape, and shows nine, small, circular bodies arranged round a central axis. The specimen is simply an impression, without preservation of any details of structure.

? Coniferous fragments.

A number of specimens (of which three are figured) are apparently coniferous, but they give very little indication of their affinities. Their general appearance suggests a comparison with *Elatides*, but this is only a suggestion—two of the figured examples (F3165, F3164A), Plate VI, figs. 5, 6, resemble foliage shoots, whilst the third (F3160), Plate VI, fig. 3, may possibly be a cone. Comparison is suggested with examples from the Jurassic of Sutherland, Scotland, figured by Seward.[3]

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[1] Walkom (19*a*), p. 12; (20), p. 17.

[2] *Ib.* (19*a*), p. 46.

[3] Trans. R. Soc. Edinb., xlvii, pt. iv, Pl. viii, figs. 22, 30.

(*b*) *Summary and Conclusions regarding the age of the Flora.*

The flora of the Talbragar Beds as described in the present paper, consists of the following species :—

Cladophlebis australis (Morris).
Coniopteris hymenophylloides (Brongn.).
Thinnfeldia Feistmanteli, Johnston.
Thinnfeldia talbragarensis, n.sp.
Thinnfeldia pinnata, n.sp.
Tæniopteris spatulata, McClelland.
Podozamites lanceolatus (Lindley & Hutton).
Araucarites grandis, n.sp.
(?) *Brachyphyllum* sp.
Elatocladus plana (Feistmantel).
(?) *Pagiophyllum peregrinum* (Lindley & Hutton).

In addition there are specimens of cones which do not supply sufficient evidence for their identification, and a number of coniferous branches somewhat similar in general appearance to figured examples of *Elatides*.

Most of the species in the above list had been recognised previously from Talbragar, and it is mainly on account of recent changes in nomenclature that the list appears to differ from the earlier determinations quoted above (pp. 2, 3).

Of my list, *Cladophlebis australis*, *Brachyphyllum* sp., (*?*) *Pagiophyllum peregrinum*, and *Araucarites grandis*, or their equivalents, did not appear in the lists above prepared by Messrs. R. Etheridge, junior, and W. S. Dun. The following comparison indicates what are considered the equivalents of the earlier determinations :—

Tæniopteris Daintreei, McCoy	=	*T. spatulata*, McClelland.
Thinnfeldia odontopteroides, Morris *Thinnfeldia* sp.	=	*T. Feistmanteli.* *T. talbragarensis.*
Taxites (cf. *T. planus*)	=	*Elatocladus plana.*
Neuropteridium australe? T.-W.	=	*? Thinnfeldia pinnata*, n.sp.
Sphenopteris sp.	=	*Coniopteris hymenophylloides.*
Podozamites spathulatus, Fmtl.	=	*? P. lanceolatus.*
Podozamites longifolius, McCoy	=	*Elatocladus* sp. (possibly *E. plana*).

Perhaps the most remarkable feature of the flora of the Talbragar Beds is the large percentage of cosmopolitan types.

All the species, except the two Thinnfeldias proposed as new, have a wide geographical range in rocks of Jurassic age. Some idea of this wide distribution of the species is given in the following table :—

TABLE SHOWING THE WIDE GEOGRAPHICAL DISTRIBUTION OF THE SPECIES OF PLANTS OCCURRING IN THE TALBRAGAR BEDS.

	Australia.	New Zealand.	South Africa.	Great Britain.	Continental Europe.	India.	Afghanistan.	China, Siberia, &c.	Japan.	North America.	South America.
Cladophlebis australis	x	x	x	x	x	x	x	x	x	x	x
Coniopteris hymenophylloides	x	x	...	x	x	x	x	x	x	x	x
Thinnfeldia Feistmanteli	x	x	...	...	...	...	...	...	...	...	x
Thinnfeldia talbragarensis	x	...	...	...	...	...	...	...	...	...	...
Thinnfeldia pinnata	x	...	...	...	...	...	...	...	...	...	...
Tæniopteris spatulata	x	x	...	...	...	x	...	...	...	...	...
Podozamites lanceolatus	x	...	...	x	x	x	x	x	x	x	...
Araucarites (scales)	x	x	x	x	x	x	...	...	...	x	x
Brachyphyllum sp.	x	x	...	x	...	...	...	...	...	x	...
Elatocladus plana	x	...	...	...	...	x	...	...	...	...	...
Pagiophyllum peregrinum	x	x	...	x	x	...	...	...	...	x	...

The absence of *Ginkgo* and *Baiera* calls for remark. These are of very widespread occurrence in Jurassic strata, and it is remarkable that there appears to be a complete absence of anything which might possibly be referred to either genus from the Talbragar collections.

Cladophlebis australis is one of the commonest and most widespread of Mesozoic plants. It occurs abundantly in rocks from Upper Triassic to Lower Cretaceous, and is of world-wide geographic range (*see* table). In Australasia it is common in Upper Triassic (Ipswich, Queensland), Rhætic (New Zealand), Jurassic (Queensland and Victoria), and Lower Cretaceous (Burrum Series, Queensland) rocks. It is perhaps remarkable that it is of such rare occurrence in the Talbragar Beds.

Coniopteris hymenophylloides is another very cosmopolitan type, but has a more restricted vertical range, being most prominent in the Jurassic; probably many examples of very similar types of sterile fronds described from Lower Cretaceous rocks represent this or very closely allied species.

Thinnfeldia has a range in Australasia from Triassic (Narrabeen Series) to Jurassic (Walloon Series). It also occurs in South Africa, in the Stormberg Series, and South America, at Cacheuta, in rocks that are of Upper Triassic or Jurassic age.

The types of *Thinnfeldia* occurring in the Southern Hemisphere are specifically distinct from those of the Northern Hemisphere. Gothan, indeed, proposed a new generic name (*Dicroidium*) for them, but on insufficient grounds.[1] The Northern Hemisphere Thinnfeldias occur in both Triassic and Jurassic strata.

Taeniopteris spatulata is the most characteristic plant of the Australian Jurassic, having nowhere been found in Australia in rocks older than those now classed as Jurassic (Walloon Series, and its equivalents of Queensland, Clarence and Artesian Series of New South Wales, etc.). In India it occurs in the Rajmahal Series of Bengal and other parts. It has been recorded from somewhat older rocks (Rhætic), in Tonkin and New Zealand, but we do not yet know the relative ages of these strata and the Australian Triassic and Jurassic. A study of the flora of the Ipswich Series in Queensland has indicated that that Series is probably somewhat older than Rhætic.[2] The so-called Jurassic rocks in Australia represent a considerable thickness of strata, and whether some of their lower portion corresponds to what many European authors term Rhætic, it is impossible to say at present.

The statement, however, still holds good, that *T. spatulata* is not known in the Triassic of Australia.

Podozamites lanceolatus is another extremely common Mesozoic plant, ranging from Rhætic to Cretaceous. In spite of its abundance it has not yet been found definitely associated with cones, but the probability is that it belongs to the Conifers.

Seed-bearing scales of Araucarian cones are of widespread occurrence in Jurassic and also in Cretaceous rocks. In Australia they occur also in the Clarence Series of New South Wales (Jurassic), in the Jurassic of Victoria, and in the Burrum Series (L. Cretaceous) in Queensland.

Elatocladus plana occurs in the Jurassic of India, as well as in rocks of similar age in Queensland. Closely allied types occur in Jurassic rocks in Victoria and New Zealand.

Pagiophyllum peregrinum is a Jurassic type of very common occurrence in the European Jurassic (Lias), and is also found in rocks classed by Arber as Middle Jurassic in New Zealand. In Australia it ascends into the Lower Cretaceous, being a fairly common constituent of the flora of the Burrum Series in Queensland.

From this short summary of the ranges of the species comprising the flora of the Talbragar Beds, it will be seen that in determining its age we must be guided by the facies of the flora as a whole, rather than by individual species.

[1] *See* Q'land Geol. Surv., Pub. 257, p. 13.
[2] Proc. Linn. Soc. N.S.W., xliii, 1918, p. 71.

A general survey of the flora undoubtedly indicates a Jurassic age for the rocks in which the plants occur. A comparison of the flora with other fossil plant assemblages known in Australia affords confirmation of this conclusion. The Talbragar flora shows closer affinities with the Jurassic floras of Australia than with those of other horizons. The closer relation to the Jurassic floras than to other Australian Mesozoic floras is conclusively indicated by the following table :—

TABLE SHOWING OCCURRENCE OF SPECIES FROM TALBRAGAR BEDS IN OTHER AUSTRALASIAN MESOZOIC STRATA.

		Jurassic				Triassic.				
	Talbragar.	Clarence Series.	Walloon Series (Qland).	Victoria.	New Zealand.	Ipswich Series (Qland).	Wianamatta Series.	Hawkesbury Series.	Narrabeen Series.	Burrum Series. (Cretaceous).
Cladophlebis australis	x	x	x	x	x	x	x	...	...	x
Coniopteris hymenophylloides	x	x	...	x	x	...	...	...	...	...
Thinnfeldia Feistmanteli	x	...	x	...	x	x	x	x	x	...
Thinnfeldia talbragarensis	x	...	...	...	...	...	...	...	...	...
Thinnfeldia pinnata	x	x ?	...	...	...	...	...	...	...	...
Taeniopteris spatulata	x	x	x	x	x	...	...	...	...	x
Brachyphyllum sp.	x	...	x ?	x	...	...	...	...	?	...
Elatocladus plana	x	...	x	x ?	(*a*)	...	...	...	...	x
? Pagiophyllum peregrinum	x	...	...	...	x	...	...	...	...	x
Podozamites lanceolatus	x	(*a*)	...	x	(*a*)	...	...	...	...	x
Araucarites grandis	x	(*a*)	...	(*a*)	(*a*)	...	...	...	...	(*a*)

(*a*) = Allied species.

Of the eleven species occurring at Talbragar, nine, possibly ten, are found in the other Jurassic floras of Australia; two, possibly three, in the Triassic floras of New South Wales and Queensland, and five, possibly six, in the Lower Cretaceous flora of Queensland. We may therefore state that the Talbragar flora as a whole shows little affinity with either the Ipswich flora of Queensland or the Narrabeen, Hawkesbury or Wianamatta floras of New South Wales. There is a greater affinity with the Lower Cretaceous Flora of the Burrum Series of Queensland, indicated mainly by the coniferous species present, but the presence of the *Thinnfeldias* and *Coniopteris* in the Talbragar Beds points to their being older than the Burrum Series. From the evidence available, then, the only possible conclusion seems to be that the Talbragar Beds are of Jurassic Age, and the probability is that they belong to the lower portion of the Jurassic System.

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EXPLANATION OF PLATES.

(Figures are natural size unless stated otherwise.)

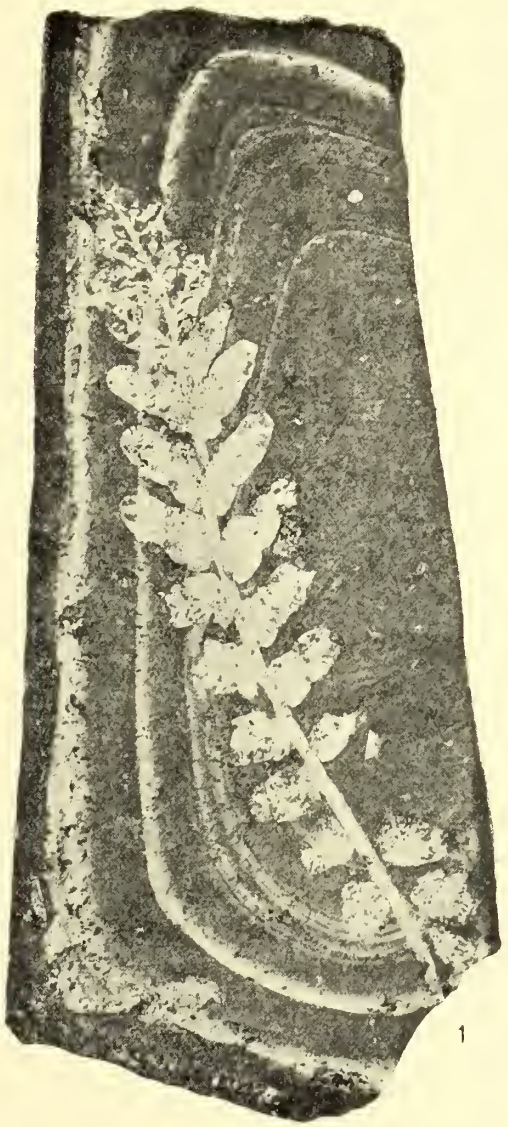
PLATE I.

PAGE.

Fig. 1.—*Thinnfeldia talbragarensis*, n.sp. Specimen F3147 9

Fig. 2.—*Thinnfeldia talbragarensis*, n.sp. Specimen F3146 9

Figs. 3–6.—*Coniopteris hymenophylloides*, Brongn. Portions of characteristic sterile fronds. Specimens F3145, F12465, F12467, F12464 7



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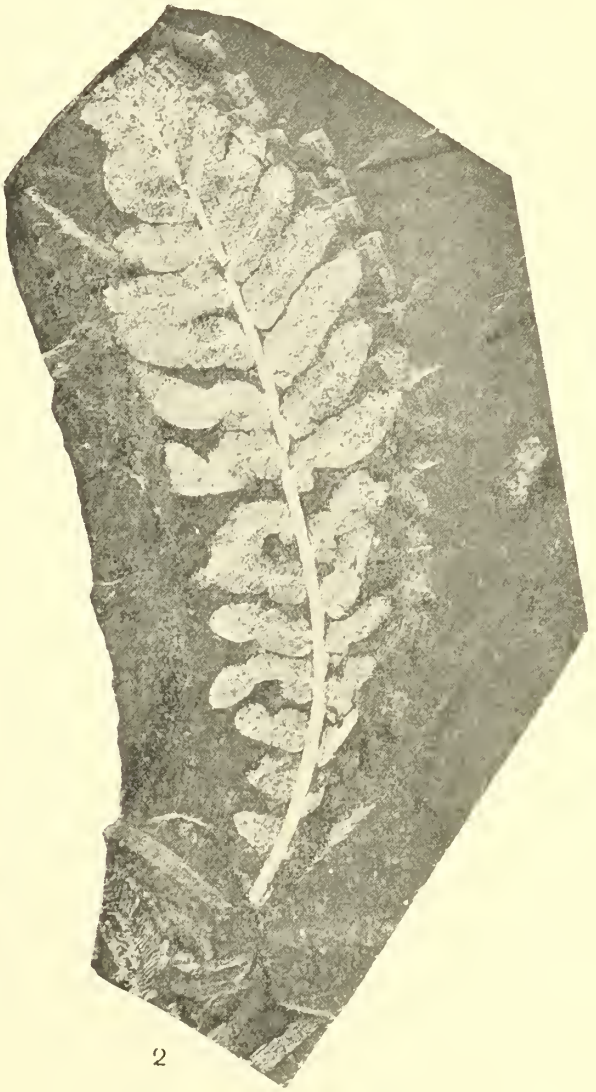

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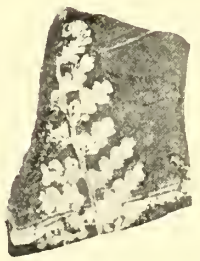

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PLATE II.

PAGE.

Figs. 1–4.—*Thinnfeldia pinnata*, n.sp. Figure 2 shows pinnules from Fig. 1 enlarged (x 2) to show the venation. Specimens F3141, F3139, F3137 6

Figs. 5–6.—*Cladophlebis australis* (Morris). Figure 6 shows portion of figure 5 enlarged (x 2) to show the venation. Specimen F3144 7

Figs. 7–9.—*Thinnfeldia talbragarensis*, n.sp. Figure 8, portion of figure 7 enlarged to show the venation. Figure 9 also shows portion of an example of *Tæniopteris spatulata*, McClelland. Specimens F12463 and F3140 9

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6 (×2)

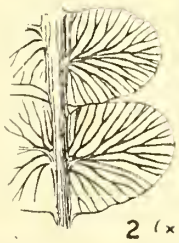

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PLATE III.

PAGE.

Fig. 1—*Tæniopteris spatulata*, McClelland. Specimen F11742 11

Fig. 2.—*Pagiophyllum peregrinum* (Lindley and Hutton). Specimen F3166 15

Fig. 3.—*Tæniopteris* cf. *Carruthersi*, Tenison-Woods, from Cockabutta Mt. Drawn from Specimen F3130a 5

Figs. 4-5.—*Brachyphyllum* sp. Figure 5, a small portion of figure 4 enlarged (x 4) to show the arrangement of the leaves. Specimen F3169 14

Fig. 6.—*Araucarites grandis*, n.sp. Specimen F3170 13

1

2

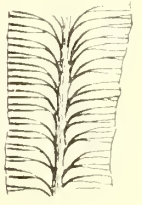

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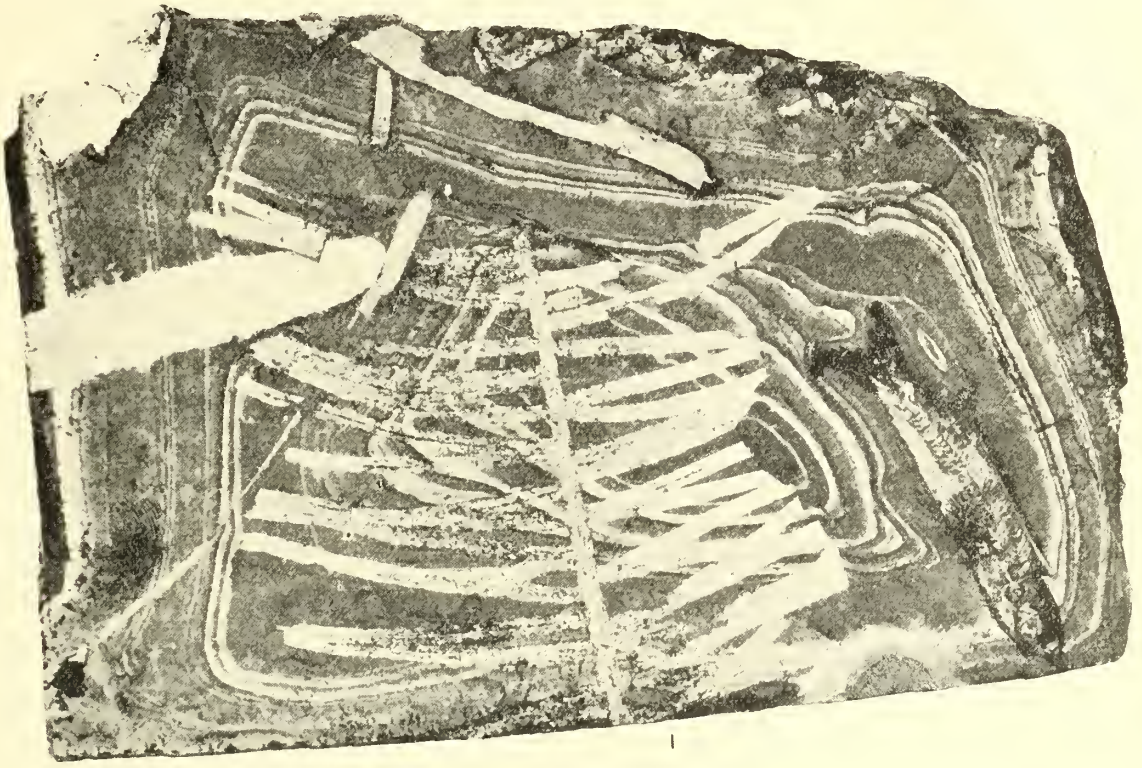
PLATE IV.

PAGE.

Figs. 1–4.—*Elatocladus plana* (Feistmantel). Figure 2, portion of figure 1 to show attachment of leaves; figure 4, portion of figure 3 enlarged (x 2) indicating spiral attachment of leaves. Specimens F3157 and F3154 11



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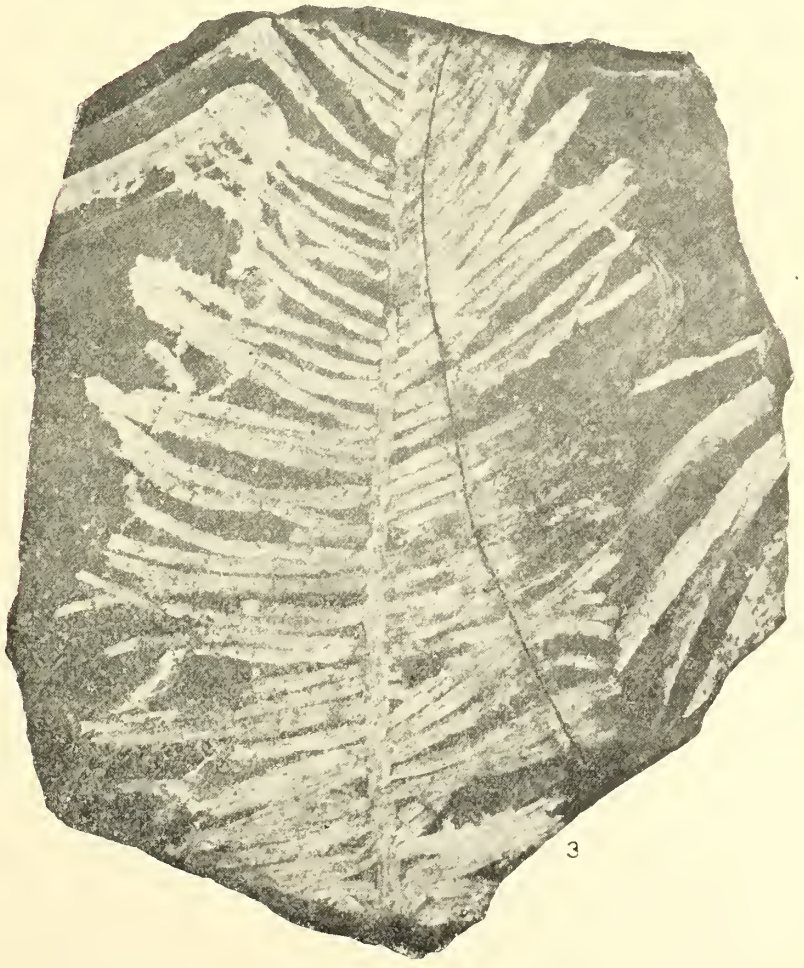

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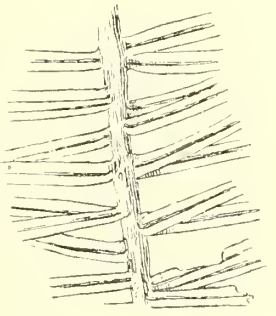

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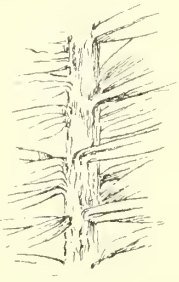

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PLATE V.

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Figs. 1–3.—*Elatocladus plana* (Feistmantel). Examples with leaves more acutely inclined to axis. The dark impressions on either side of the *Elatocladus* in figure 2 are dendritic markings. Specimens F3159, F3161 and F12466 14

Figs. 4–5.—*Podozamites lanceolatus* (Lindley and Hutton). Specimens F3152 and F3155 12

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PLATE VI.

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Figs. 1–2.—*Podozamites lanceolatus* (Lindley and Hutton). Figure 2 drawn to show attachment of leaves. Specimen F12462 12

Fig. 3.—Coniferous branch. Specimen F3160 16

Fig. 4.—? Cone. Specimen F3163 16

Fig. 4*a*.—Drawing of ? Cone in Fig. 4 16

Fig. 5.—? Coniferous branch. Specimen F3165 16

Fig. 6.—? Coniferous branch. Specimen F3164*a* 16

Fig. 7.—? Cone. Specimen F3163 16

Fig. 8.—? Araucarian cone impression and *Tæniopteris spatulata*. Specimen F3168 ... 16

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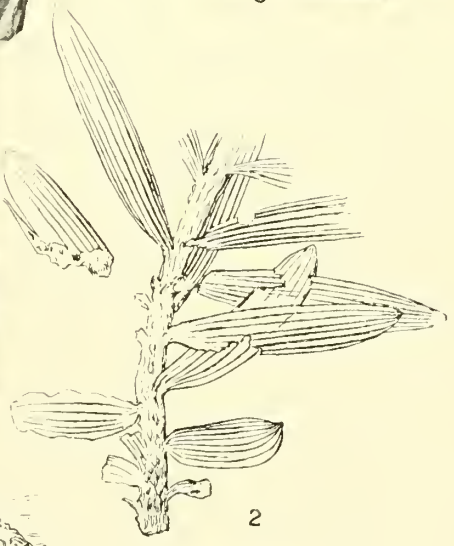

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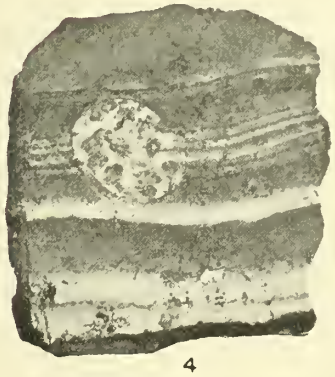

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